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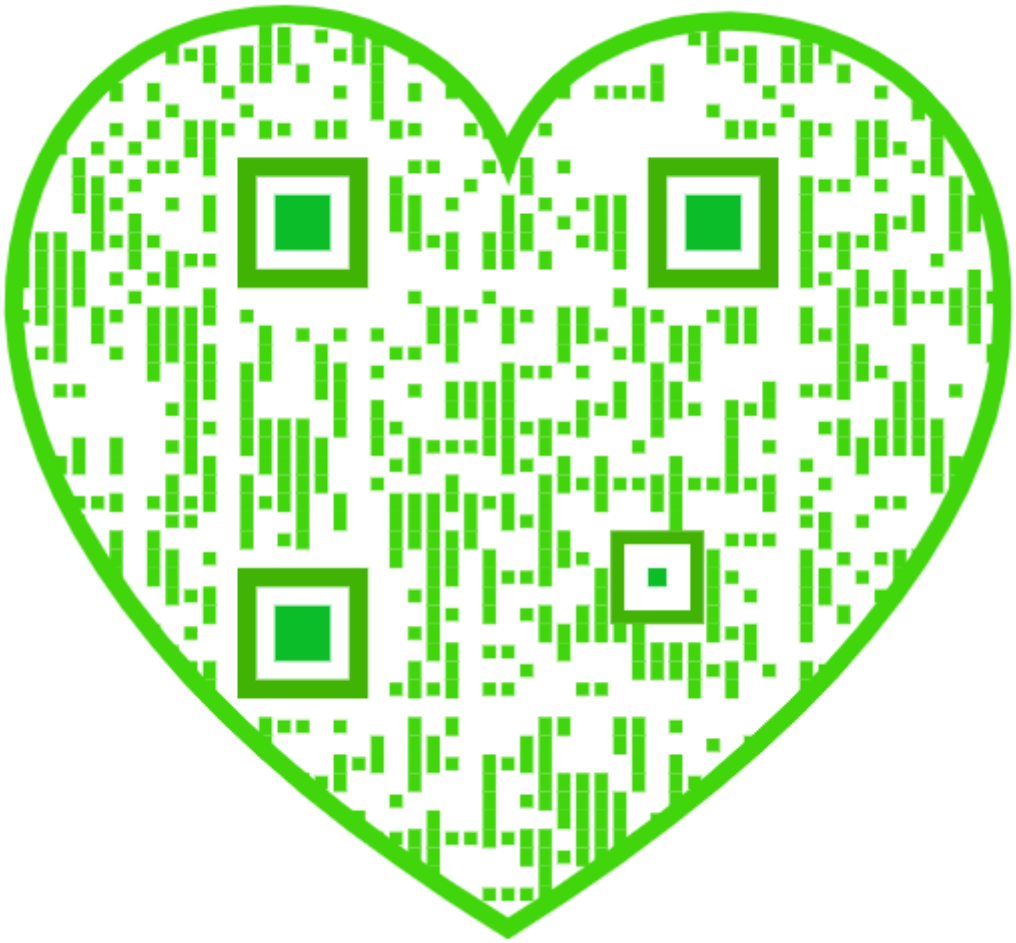

# MUSHROOMS.

## GUIDE TO MUSHROOM CULTURE
(FIFTH EDITION.)

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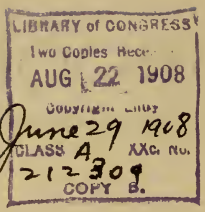



"It is safe to say that although mushroom production has doubled in the United States within a period of five years, the market could take twice the quantity now being received without materially affecting the value of the product. . . . . the price at present paid for fresh mushrooms makes it a paying business when the conditions are favorable and when good care and the best cultural intelligence are brought to bear on the work."—Cyclopedia of American Agriculture, Vol. II.

# INTRODUCTORY.

Realizing the need of more explicit directions for the cultivation of mushrooms—a full discussion of every phase of the work in detail—we have enlarged this, the fifth edition of our "Guide to Mushroom Culture" to such an extent as to make it advisable to publish the two parts "Pure Culture Spawn" and "Guide to Mushroom Culture" separately. Each step in the work of mushroom growing is taken up in minute detail, and is treated in the light of recent methods,—methods which have made it necessary for the grower of yesterday either to revise his methods or step aside and let science take the lead.

## Bulletins On Mushroom Culture.

Up to the time mushroom investigations by the United States Department of Agriculture were discontinued the various bulletins on mushroom growing issued by said Department of Agriculture and by several State Experiment Stations composed the most complete and authentic guide available to the grower. These publications have been the most important factor in eliminating the haphazard methods manifest in mushroom growing only a few years ago. Although the past two years have witnessed more rapid progress than preceeding years no systematic treatise, setting forth recent developments, has appeared since the publication of B. P. I. Bulletin No. 85, "The Principles of Mushroom Growing" etc., in 1905.

## "The Mushroom."

Generally speaking, the term "mushroom" may designate any one of the numerous species of fleshy fungi, while speaking in a commercial sense, "the mushroom" refers only to the several species of *Agaricaceae* (*A. campestris, arvensis, fabaceus, and villaticus*) now under cultivation. The layman groups all fleshy fungi into two classes: "*mushrooms*" and "*toadstools.*" We readily see that such a division is not sustained when varieties last year grouped in the "*toadstool*" class are now recognized as edible mushrooms. The terms are used interchangably and should be synonymous.

## Selecting A Place To Grow Mushrooms.

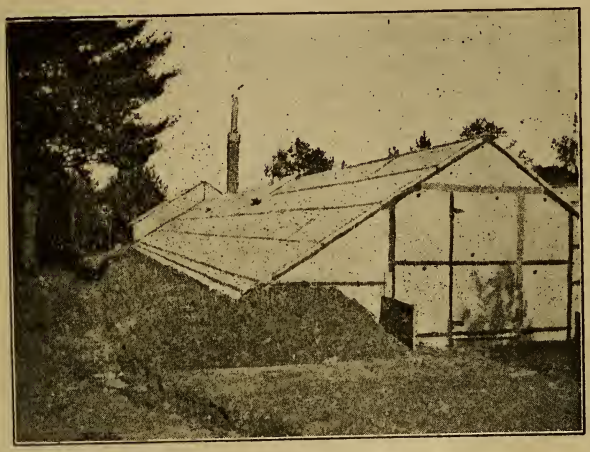
The Pure Culture Method has made possible the introduction of varieties of mushrooms adapted to different temperatures, thus making it possible now to grow mushrooms under a much wider range of conditions than heretofore. The essential condition and determining factor in selecting a place to grow mushrooms is a moderate, even temperature, where extremes can be avoided. Cellars, caves and mines are of the first importance, since here the temperature varies very little, and mushrooms may be grown the year round.

**The Residence Cellar For the Home Grower.** For growing a home supply, and to one beginning to grow mushrooms for the market, there is no better place than the residence cellar or basement. By preparing the compost at the stable and transferring it to the cellar after it has been carried through the early stages of fermentation, no unpleasant odor will be brought into the cellar. Nine-tenths of the mushrooms grown for home use are produced on cellar beds—beds made directly on the floor, in boxes, or on tables and shelves.

**Cellars, Caves, Mines, Etc.** Large cellars, (abandoned breweries, packing houses and wine cellars) caves, basements, tunnels and mines are unexcelled for commercial mushroom growing. In such places the temperature is usually very favorable for the culture of mushrooms throughout the entire year, thus not only eliminating the cost of heating (which is a factor to be taken into account when growing mushrooms in buildings above ground) but making it possible for the grower to supply his trade with the same variety right along, summer and winter. In caves and mines it is important to avoid all possible danger of flooding by seepage or high water. Usually the ventilation in such places is quite sufficient. Draughts must be avoided.

**Mushroom Culture in Houses, Barns, Stalls and Sheds** is, next to cellar culture, the most common method. Some of the largest mushroom establishments in this country consist altogether of specially built mushroom houses almost entirely above ground. Such

houses are constructed with double walls and roof, resembling in this respect an ice house. Better insulation is obtained by using builders' felt between the walls. The roof is usually covered with a rubber or felt roofing material (see Fig. 1). The extent of mush-



One of the mushroom houses on Epicure Farm, Portland, Me., built of 2x4s, boarded with inch boards. Roof and sides are covered with paroid roofing. Sides are banked with dirt. House 20 ft. wide and side walls are 2 ft. high, heated with hot water system.

room culture in houses, greenhouses, etc., has been greatly augmented by the introduction of warm weather species which have made it possible even under such conditions to grow mushrooms throughout the summer months. A heating system similar to that employed in greenhouses is used to control the temperature in winter. The space under greenhouse benches may be used very profitably for growing mushrooms.*

## Ventilators And Windows.

The ventilators in cellars, basements and mushroom houses should be placed in or near the roof, and should be so constructed as to prevent intense rays of light from falling on the mushroom bed. Diffuse light

* Authority: Nineteenth annual report of the Massachusetts Agricultural Experiment Station, page 211,

is not injurious but, like other fungi, the growth of the mushroom is retarded by intense light. Darken the windows with curtains. Absolute darkness, though not essential, is preferable, because it prevents the occurrence of flies and other insects frequently found in the mushroom house. If the outside temperature is such that the ventilators can not remain open continually they should be opened at least an hour or two daily. A wire screen over the ventilators will prevent flies and insects from entering the mushroom house.

## An Economic Arrangement Of Beds.

The experienced grower will so divide his space that he may put in beds at intervals of about three months throughout the year, thus keeping some portion of the house always in bearing. Additional advantages of such a plan over that where the entire area is bedded at once are that it requires fewer employes and permits a more thorough and careful preparation of the materials. A small number of employees continuously engaged in the work attain greater efficiency and perform better service than a larger number employed only a few weeks or months.

## Open Air Culture.

**Causes of Failure.** The culture of mushrooms in the open has received little attention in this country and, even today, the record of successes attained out of doors is so overwhelmingly outnumbered by the many failures that the idea is generally accepted that mushrooms cannot be grown successfully in the open. These failures may be attributed to several causes: (1) A lack of information concerning the relationship existing between the minute organisms (bacteria) of the compost and the spawn. With a better understanding of the causes of fermentation of manure and of the conditions which govern the rapidity of fermentation, we realize, as never before, that there is a distinct relation between the activity of the minute organisms which bring about the decomposition of the manure, and the development of the spawn. Under the ordinary methods of culture in cellars and houses, where the grower has absolute control of the temperature and

moisture, the activity of these organisms can be so regulated as to bring about the most favorable condition for the development of the spawn. In the open we can control conditions only to a limited extent; consequently the same methods of culture will not apply. Growers formerly failed to recognize this distinction. (2) The use of spawn poorly adapted to the conditions and environment. Prior to the development of special strains of mushrooms, made possible only since the introduction of PURE CULTURE SPAWN, *A. campestris* was practically the only species cultivated. The temperature range of this mushroom (52° to 63° F) limits its culture in the open to a few months during the spring and fall. Under the most favorable conditions spawn, planted in early spring, may survive the summer months and produce a few mushrooms before the winter begins. With the hardier strains (*A. arvensis*) now available to the grower, even though we had not improved the culture conditions, the margin between the number of successes and the number of failures should be reduced very materially. (3) The use of worthless spawn. It is suggested and recommended, even today, by some dealers and spawn makers that old spawn—because it may be obtained at a reduced price—can be used more economically in open air culture than good, fresh spawn. This is untrue and is very misleading. Successful results cannot be obtained except with the best fresh spawn, and poor seed should never be used no matter what the price. Why should you plant spawn in a bed out of doors that is not fit to use in your mushroom house?

## Time Of Planting Out-Door Beds.

Mushroom culture in the open in the United States, with the exception of a portion of the Pacific coast country, is limited to certain seasons of the year. In the southern section, south of San Antonio, Vicksburg, and Atlanta, out-door plantings should be made in October and November. Such beds will bear from about Christmas until very warm weather sets in. In the Central and South Central States plantings in the open should be made as early in spring as weather conditions permit—say from the first of March till the

middle of April. Along the Pacific Coast, from Eureka to Los Angeles, Cal., open air culture (so far as temperature is concerned) is practicable the entire year. This, together with the unusual demand for fresh mushrooms, particularly during the tourist's season, makes southern California one of the most promising mushroom centers in the United States. While actual figures, showing the development of the mushroom industry in this section, are not available, conservative estimates place the yield of the present season at four times that of two years ago.

## Temperature And Moisture.

**Influence On The Microscopic Flora Of The Compost.** Fermentation of the manure is due to the action of minute organisms and, as stated in a previous paragraph, a definite relation exists between the developing spawn and this microscopic plant life ever present in the compost. The activity of these organisms is influenced by the degree of temperature and moisture, consequently these factors play an important role in mushroom growing. While they may have much in common, this relationship between the microscopic flora of the mushroom bed and mushroom spawn, as now understood, is not mutual; and, except in so far as the food constitutents are rendered more readily soluble by the process of decomposition, we may assume that there is an incessant state of competion going on within the mushroom bed. Temperature and moisture are the agencies through which we control bacterial activity, and a proper moisture and temperature condition in mushroom growing implies that average mean which enables the growing spawn to overcome the retarding influence of these organisms. The introduction and development of species of mushrooms adapted to different temperatures clearly indicates that this mean is not constant, but that it varies with different strains of mushrooms.

**Optimum Temperature For Different Species.** In the light of these facts we may account for the relatively slow growth of mushroom spawn on unfermented manure and in high temperatures. The temperature, moreover, may not be above that normally considered

as optimum. Unfermented manure, however, furnishes a more favorable medium for bacteria development consequently the development of the spawn is retarded. In general it has been found that the optimum temperature for growing the different species of *Agaricacede* is approximately as follows:

| | | |
|---|---|---|
| Agaricus | campestris . . . | 53° to 58° F. |
| " | arvensis . . . | 58° to 62° F. |
| " | villaticus . . . | 63° to 68° F. |
| " | fabaceus . . . | 75° to 85° F. |

Effect Of High And Low Temerature. The immediate effect of an unfavorably high temperature on the plant—the sporophore—is manifest in a rapid elongation of the stem (stipe), sometimes accompanied by a corresponding decrease in the size of the cap, thus developing a mushroom very much out of the usual proportions. The effect of a temperature below the optimum manifests itself in the development of a very short, thick stem, large cap, and slow growth.

Relation Between Moisture And Temperature. From the foregoing it will be readily seen that the moisture and temperature conditions are closely related, and that a change of one modifies to a certain degree the influence of the other on growing spawn. In other words, a high temperature should be accompanied by a greater per cent of moisture than is present at a low temperature. The degree of moisture may vary in different sections of the country and at different seasons, but in general about 55 per cent will be found satisfactory. This likewise varies with different species. The high temperature species require less moisture than *A. campestris.* The texture of the bed will also govern to a certain extent the degree of moisture most favorable for spawn growth. An open strawy material will require more moisture than a bed practically free from straw and litter. The most satisfactory test, and one the experienced grower may rely on in determining the moisture condition, consists in taking a handful of the compost and squeezing it very hard. With the proper degree of moisture a slight amount of water should ooze out between the fingers, but not sufficient to drip from the hand. (Watering the

beds is taken up in another chapter.)

**Atmospheric Moisture In The Mushroom House.** A humid atmosphere is desirable in the mushroom house and is one of the prime essentials in successful mushroom growing. This does not mean that the place should be so damp as to be dripping with water, but, unless a fairly moist condition of the atmosphere prevails at all times, too rapid evaporation may occur. Ventilators of the mushroom house should be so regulated as to insure a slight but constant evaporation from the surface of the beds. An intermittent dry and moist atmospheric condition will shorten the life (fruiting period) of a bed and very materially injure the quality of the product. The effect of an extremely dry atmosphere manifests itself in the development of mushrooms of irregular form with caps cracked and torn.

These facts taken into consideration, the grower will readily understand why cellars, basements, caves, etc., with a constant temperature and moisture condition, are of first importance in commercial mushroom growing, and that in the construction of a mushroom house these factors must ever be kept in view.

## Materials For Mushroom Beds.

Among the various materials that have been tried in mushroom culture none have been found better than fresh stable manure, particularly that from stables where the horses (or mules) are bedded with straw. It's superiority is not due wholly to the content of plant food, but beds made thereof have a texture peculiarly adapted to the most vigorous development of the spawn. Beds made from this material invariably excel other beds in productiveness. On account of the greater expense of bedding animals with straw, as compared with sawdust and shavings, many stables now use these latter materials, and it is becoming more difficult each year to obtain straw manure. Beds made from shavings manure, properly fermented and treated with lime, produce excellent yields. Manure from stables in which timothy or prairie hay is used for bedding the animals should never be used for mushroom beds. Manure from animals fed on "ship stuff"

or other cheap rations, is unfit for mushroom growing and should be carefully avoided. It is also very important that those stables in which the manure is treated with poisonous disinfectants, and particularly veterinary hospitals, be avoided when selecting material for the mushroom bed.

Deep Stall Fermentation. Except when the manure has been left in the stall and is daily trampled upon by the animals it should not be used when more than ten days or two weeks old. When it remains in the stall and is tramped down by the animal, the manure is preserved in excellent condition for months.

Decayed Leaves make an excellent substitute for stable manure in mushroom beds. It is necessary however to mix soil with the leaves, otherwise the bed will be of a very loose texture. Gather the leaves in late summer as they fall and are swept up on the street. If sufficiently moist when gathered into a pile, fermentation will set in immediately. It is best to mix a little soil with the leaves at once that fermentation may be more gradual. When decomposed to such an extent that the blade may readily be broken from the ribs and veins the material is in good condition for making into beds. Mix one bushel of garden dirt with two bushels of leaves. Fertilization is essential in all cases to obtain maximum results.

## Preparing The Compost.

Importance of Careful Fermentation. Recent results have shown that the importance of proper fermentation of manure for mushroom beds has not been sufficiently emphasized in previous publications. It is a very important factor in determining the quality and quantity of the yield of a bed. The solid manure contains, principally, fertilizing constituents of the food which have not been digested or absorbed into the animal system and are therefore in insoluble form. By the process of fermentation this food is rendered more readily soluble. Liquid manure, on the other hand, contains those fertilizing constituents which have been digested and are readily available. This explains the stimulative effect observed after applying liquid manure

to old beds. It is analagous to the application of readily available food in the form of commercial fertilizers.

**Loss Of Plant Food By Leaching.** Just as it is important to render the difficultly soluble food more readily soluble by fermentation, it is equally as important that the soluble food should be preserved, and every precaution should be taken to prevent a loss of food by leaching. The fermenting pile should not be exposed to drenching rains as this invariably results in a rapid depletion of the essential food constituents of the compost, particularly the soluble mineral elements. More uniform results are therefore obtained when the manure is fermented under shelter.

**In Commercial Mushroom Growing** the manure is usually fermented in ricks about four feet deep, ten to twelve feet wide and as long as might be necessary or convenient. As the rick is being made the manure, if dry, should be well moistened throughout and tramped down. If piled loosely and not sufficiently moist, fermentation will take place so rapidly as to cause an injuriously high temperature, the immediate effect of which is manifest in "fire-fanging" and a strong ammonical smell. *

**The First Turning.** By the end of the first day the manure pile will become quite warm within and a thermometer should be used to ascertain the exact temperature. Insert the thermometer 10 to 15 inches. After three or four days the temperature will have risen to near 130° F. and the entire mass should be forked over into a new rick. This is called the "*first turning*" When turning the manure pile all lumps should be shaken to pieces and the outer portion of the old rick should be in the interior of the new pile that all may ferment uniformly. Always pack the new rick when turning the manure pile.

**Second And Third Turning.** The temperature of the new rick will begin to rise immediately, though not so rapidly as before. It may be necessary to spray

* "Firefangs" is a white fungus growth induced by a very high temperature, and is usually first observed several inches under the surface of the manure pile.

the surface of the new rick about the third day to prevent "fire-fanging." Turn the pile again when the temperature approaches the danger point (130° F.), usually between the fourth and sixth days. Generally a third turning is necessary about a week later, though sometimes the compost is ready to be made into beds at this time.

Condition For Making Into Beds. Before the compost is in prime condition for making into beds it should lose the stable odor and should have a sweet smell not unlike that of fresh mushrooms; the color will have become brown and it will appear greasy to the touch. The temperature should be between 115° and 100° F.

Using Soil To Check Fermentation. Some growers cover the compost pile with about three inches of soil, thus filling the pores of the mass and thereby checking fermentation and evaporation. Manure treated in this manner ferments slowly but gradually, and the additional labor involved in applying the soil is offset by a saving of one or more "*turnings*" required when the rick is not covered. Mixing soil with the manure will have the same effect on fermentation and evaporation.

Extreme Temperature Injurious. Results obtained through experiments along this line indicate that from 120° F. to 130° F. is the most favorable temperature for fermenting manure for mushroom beds, and that when the heat of fermentation exceeds this limit the quality of the material is impaired. The injury is partly due to a loss of nitrogen perhaps, but more particularly to a transformation of the mineral food constituents into compounds which cannot be assimilated by the spawn. This transformation probably consists in a breaking down of the more complex compounds into simpler forms—a direct effect of the fungus growth referred to as "fire-fangs."

Water And Fermentation. Particular attention should be given at all times to the amount of moisture in the manure. It is a very effective means of controlling

fermentation. The addition of water reduces the temperature and thus retards fermentation. Also, by filling up the pores of the mass thus excluding the air, it checks fermentation within the pile. "Fire-fanging" can be checked to a great extent by regular sprayings. Under the most favorable moisture condition a slight amount of water will drip from a handful of the material when tightly pressed between the fingers.

Fermentation More Rapid In Summer. On account of the more favorable climatic conditions for bacterial development, manure ferments more rapidly in summer than in late fall and winter. Growers should therefore exercise the greatest care in the selection and preparation of the compost at this season. Where manure is received in car lots a delay of only a few days in transit may result in serious injury to the compost, due to "fire-fanging."

Growth Of Wild Mushrooms On Manure. Except in cold weather, the compost pile, during the last stages of fermentation, will produce an abundant crop of wild mushrooms—a small species of Coprinus. This may continue to grow on the compost during the first few days after the bed is made up. The appearance of this fungus, although it often worries the amateur, is no cause for alarm, and the experienced grower takes this as a sign that the compost is approaching the stage favorable for the growth of "the mushroom."

Preparing A Small Mass Of Compost. The home grower and beginner who uses but a small quantity of compost will experience conditions different from those confronting the large commercial grower. In a small pile a greater proportion of the mass is exposed; more moisture escapes by evaporation; and fermentation becomes very active. Close attention must be given to the moisture condition, and the mass must be turned at shorter intervals (every second or third day) to prevent "fire-fanging." Covering a small pile with moist sacking or old matting is very beneficial. Some growers mix soil with the compost to check fermentation and to prevent too rapid evaporation. *

* One part of good garden soil should be used with five parts of manure.

Less time is required in the preparation of a small pile than when the manure is handled in large ricks. It should not be inferred, however, that a small mass, consisting only of several wheel-barrow loads of manure, can be properly fermented. It would be very difficult to control conditions favorable for fermentation in a mass less than one cubic yard, and it is largely for this reason that many beginners who daily collect the droppings from one or two animals, fail in their attempts to grow mushrooms. Where the grower is dependent on the material from one or two animals, the animal should be bedded in such a manner that the manure may be left in the stall until a sufficient amount has accumulated. Such manure is preserved in excellent condition when daily trampled on by the animal,* and will invariably yield better results than manure that has gradually accumulated and has been piled elsewhere.

## Fertilization In Mushroom Culture.

It is only within the past two years that commercial fertilizers have been successfully used in mushroom culture, consequently the present chapter does not by any means represent a final treatise on this question. Our aim is to acquaint the reader with the principles governing the use of commercial fertilizers on mushroom beds, the methods that have been successfully applied, and to suggest further investigation and experiments.

**Principle Of Plant Nutrition.** It is a fundamental principle of plant nutrition that every plant absolutely requires a certain minimum of the essential food elements and that in the absence of this minimum of any one nutrient element it cannot attain its normal development. This principle applied to mushroom culture means that the yield of a mushroom bed is determined by the minimum quantity of any one of the essential food constituents. That is, even though there be present in the mushroom bed an abundance of one or more food constituents in readily available form, if there is a deficiency of any one food constituent, the yield of

* Authority: Farmers' Bulletin No. 192, p. 24, U. S. Dept, of Agriculture.

such a bed will be determined by the deficient element. *

**Stable Manure** has been generally regarded by the mushroom grower as a medium supplying all the food necessary for the growth of the mushroom. While this is quite true, recent investigations reveal the fact that the commercial culture of mushrooms on manure alone is not the most economical method. Through extensive nutrition experiments in the laboratory as well as thorough tests on beds to which the essential elements were applied in different proportions, it has been demonstrated that the nutrients as supplied by manure alone are an "unbalanced food."

**Analyses Of Stable Manure** shows that it contains approximately 0.49 per cent Nitrogen, 0.26 per rent Phosphoric acid and 0.48 per cent Potash. This represents the amount of these elements actually present, as indicated by the chemist's analysis when manure is fermented under the most favorable conditions, and should not be taken as indicating the per cent of available food. Under the usual method of fermentation it is probable that less than one-third of the mineral foods present become available during the average life of the mushroom bed. All food must first pass into solution before it can be taken up by the plant.

**The Mushroom Is A Heavy Feeder** and to obtain the best quality and largest yields, large quantities of available food are absolutely essential. It is moreover an artificial crop and the grower has complete control of all conditions affecting growth. We should therefore obtain a more liberal response to proper feeding with commercial fertilizers than that obtained from other crops, all of which are to a great extent dependent upon climatic conditions over which the grower has no control. The profit from the use of fertilizers is measured to a large degree by the perfection of soil conditions, and it is only in the absence of unfavorable

* Illustration: If we have sufficient nitrogen and potash present in a mushroom bed to produce two pounds of mushrooms per sq. foot of surface, but only sufficient phosphoric acid to produce one-half pound per sq. foot, the yield from such a bed will be determined by the amount of phosphoric acid available and cannot exceed one-half pound per sq. foot of bed.

influences that the transformation of a maximum amount of plant food into plant substance can take place. More than this, the mushroom is a crop of very high commercial value, and for this reason will stand for the use of fertilizers which may be too expensive for other crops having a lower market value.

**Mineral Foods Most Important.** It is a well known fact among those familiar with the use of fertilizers and requirements of different kinds of soils that the heavy soils, rich in humus, are generally lacking in phosphates and potash. We would naturally expect in mushroom beds, consisting wholly of humus making materials, to find this condition manifest in an extreme degree. Results thus far obtained by fertilization show the mineral foods to be of greatest importance. The available nitrogen present in manure seems to be more than adequate for the largest yields that have ever been obtained, and it is by increasing the supply of calcium, potash and available phosphoric acid that any increase in yield can be effected. The spurts of renewed growth occasionally reported after the addition of saltpetre to a mushroom bed are perhaps not so much due to the nitrogen as to the action of the alkali in correcting the acidity of the compost.

**Present Method Of Fertilization.** The work along this line has thus far consisted merely in supplementing with commercial fertilizers the food originally present in the compost in such a manner as to obtain maximum results from the available nitrogen. This has been accomplished by adding phosphates and potash, in the form of acid phosphate and potassium sulphate, to make up the deficiency of these nutrients; also by adding slaked lime, thereby hastening the decomposition of the manure, and thus increasing the solubility of the food already present.

In the light of present knowledge of fertilization of mushroom beds, the following formulae are recommended:

Formula No. 1.—Apply one-third of a pound of slaked lime to every sq. foot of bed (33 pounds per 100 sq. ft.). Thoroughly mix the lime with the manure when bed is being made up.

Lime can readily be obtained anywhere, hence we recommend this method particularly to the home grower. If more convenient to obtain unleached wood ashes use ashes instead of lime, applying same at the rate of one-half pound per sq. foot of bed (50 pounds per 100 sq. ft.). Thoroughly mix the ashes with the manure when the latter receives the last turning. It is not necessary to screen the ashes for this purpose.

The use of lime or wood ashes as here suggested increases the yield of a bed approximately 100 per cent.

Formula No. 2.—Apply to 100 sq. feet of beds:

18 pounds slaked lime.
12 " acid phosphate, 14 to 16 per cent available.
5 " sulphate of potash, 48 to 52 per cent "

Apply the potash when the manure receives the first or second turning, but do not apply lime until bed is being made up. Thoroughly mix the fertilizer with the manure by first scattering it evenly over the surface and then forking over the entire mass.

Unless the area of beds is such that the grower would require sufficient quantities of phosphate and potash to purchase same in original bags of 225 pounds and 100 pounds respectively, it is recommended that he use formula No. 1—lime alone. Beds fertilized according to formula No. 2 continue bearing longer than beds treated with lime alone.

The price of phosphate and potash in the above forms is approximately 75 cents and $2.25 per one hundred pounds, respectively.

Lime is absolutely essential to successful mushroom culture. Aside from any manurial action that may be attributed to lime it is of paramount importance as a "sweetener," and as an aid to decomposition, thus rendering the food constituents in the manure more readily soluble. Most manures are slightly acid after fermentation, and, unless this acid condition is neutralized by the addition of lime, the development of the spawn is retarded. It is probable that lime enters into certain chemical compounds to take the place of potash and phosphoric acid, thus liberating these elements and rendering them immediately available to the plant. Lime also serves the purpose of an insecticide.

The Advantages Of Fertilization in mushroom culture are:

(1) Earlier yields.
(2) Increased productiveness.
(3) Long life of beds.
(4) Better quality of product.
(5) Greater uniformity of product.
(6) Prevention of insects.

## Mushroom Beds.

Two Types. Mushroom beds are usually made according to one of two general types, called *flat* or *ridge* beds (sometimes referred to as English and French types respectively). The former, being more easily constructed, is gaining favor among the American growers and the latter is used only in out-door work

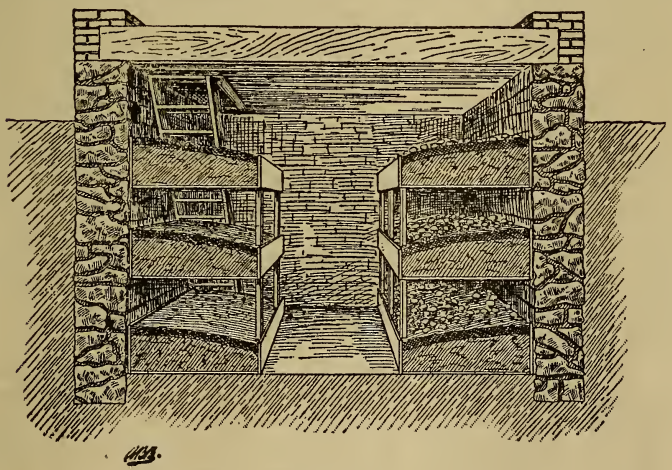


FIG. 2.

and in very moist places—such as wet caves, mines, etc. The moisture condition, in fact, is the determining factor when deciding upon the type of bed best adapted to the conditions. There being a greater amount of surface per given mass in ridge beds than in flat beds, it necessarily follows that under identical conditions of moisture more moisture will be evaporated from the ridge type than from the flat type of bed.

On account of the greater surface area of the ridge bed many growers naturally think this type of bed more remunerative than the flat bed. This conclusion however is contrary to actual experience, for the additional expense (labor) involved in constructing ridge beds above that of making flat beds more than offsets any increased returns due to greater surface area.

**The Flat Bed** (Fig. 2) should be about ten inches deep (if less than 100 sq. feet in area a depth of 12 inches is desirable). The house or cellar will determine its size and shape. Paths or walks should be so arranged that the crop can be gathered without stepping on the beds. Instead of leaving paths between the beds, some growers utilize the entire floor space for beds and place elevated walks over same at convenient intervals. In making up the beds it is not essential that the manure be put down and firmed by layers as is maintained by some writers. Having mixed in the fertilizer the entire mass may be shaped up and compressed at once.

**Ridge Beds** for indoor culture should be about two feet wide at base, 18 inches in depth, and tapering sufficiently to hold the casing in place. A convenient arrangement is to have two beds in close contact and then a walk ten inches wide, between these and the next two. A slanting bed is usually made up next to the wall. On account of the greater depth of ridge beds it is necessary to make them up in layers, thoroughly compressing each successive layer of compost as it is put down.

**Beds Must Be Packed Firm.** It is absolutely essential in both types of beds that the compost be packed very firm as soon as made up, otherwise violent fermentation may occur and greatly injure the compost. Even though fermentation has proceeded to a stage where there is no danger of further heating, the rapid loss of water from open spongy beds is detrimental. The beginner is more likely not to pack the bed firm enough than to get it too firm. A convenient tamper can be made of a block of wood 12x18 inches, six inches in thickness, with a vertical handle similar to tampers used in laying cement pavement.

**The Moisture** condition of the manure when being made up into beds is of very great importance. There

should be sufficient moisture that upon squeezing a handful very hard only a few drops of water ooze out between the fingers.

## Methods Of Out-Door Culture.

There are several methods of propagating mushrooms in the open. The grower who wishes merely to increase the natural growth of mushrooms on his lawn or meadow, and has little time to devote to the work, will seed his plot without giving same much preparation. In order not to mar the appearance of the lawn it is necessary to insert the pieces of spawn without the addition of compost. In such cases it is very essential that the lawn be given a dressing of manure either shortly before the spawn is planted or immediately after. Whenever possible, however, it is desirable to insert a small mass (say a mass twice the size of a spawn brick) of prepared stable manure with the spawn when planting. In planting, merely lift the sod with a spade and insert the spawn at a depth of 1 1-2 to 2 inches.

Another method employed by market gardeners is to insert the spawn in the compost applied in beds for forcing rhubarb and asparagus.

The pieces of spawn used in seeding a plot in the lawn or meadow should be larger than is recommended for in-door beds. Break the brick into about six pieces only. A degree of moisture favorable for the germination of seeds is most satisfactory for the developing spawn. The regularity of the season (rainfall) will determine, to a great extent, the yield of mushrooms when propagated in this manner.

The most common method, however of growing mushrooms out of doors is in open beds or in cold-frames. For this method the material used and its preparation is the same as for beds indoors. In order to modify bacterial activity within the compost and to check evaporation, soil should be mixed with the compost for out-door beds. Use one-third soil and two-thirds manure.

**Ridge Beds Preferable.** For open beds the ridge type is preferable because it will readily shed water in case of heavy rains. Such beds should be about 2 1-2 feet in width and 1 1-2 to 2 feet deep. The beds are

made up in the same way as indoor beds. Fertilizer should also be applied as is recommended for indoor culture.

**Flat Beds.** Beds enclosed as hot beds or cold-frames are usually flat. A mixture of soil and manure is desirable, as recommended for ridge beds in the open. Such beds should be about 14 inches deep and covered with straw. Use fertilizer as recommended in another chapter.

**Mulching Out-Door Beds.** As soon as the beds have been made up they should be covered with 4 or 5 inches of straw to prevent too rapid loss of moisture or sudden changes of temperature. Spawn the beds as usual, replacing the straw covering after spawning. After the spawn has begun spreading throughout the bed and begins to show in mould-like spots on the surface (under the straw), the soil casing should be applied. This casing should be one to one and a half inches in depth. Replace the straw covering again and leave it on the beds continually, removing it only while watering the beds and picking the crop.

**An Insect Preventive.** In view of the fact that mulching in-door beds with tobacco stems is a preventive of numerous insects it is highly probable that injurious insects can be prevented on out-door beds by treating the straw covering with an effective insecticide, or, even by merely mixing a considerable portion of tobacco stems with the straw mulch. The treatment with an insecticide would necessarily have to be repeated at intervals, especially after rains. It is also very important that the insecticide be non-injurious to the spawn.

**Selecting A Place For Out-Door Beds.** In selecting a place for out-door beds avoid low seepy areas. Since out-door culture is practicable throughout the central and northern states only between March and October it is desirable to select the coolest place available for the bed. See page 9 for time when beds in the open should be planted in different sections of the United States.

## Planting Or Spawning.

It is rarely ever advisable to seed a bed as soon as

it is made up. So long as manure is not thoroughly decomposed, although there is slight evidence of bacterial activity while it remains undisturbed, it almost invariably heats again when the mass is turned into a new pile. It may become so hot that another turning is necessary to prevent "fire-fanging" after the bed is made up, though this does not happen often. The temperature may however rise sufficiently to injure the spawn. It is therefore recommended that the bed be left alone three to six days after it is made up, before planting the spawn. Should fermentation set in anew the temperature will begin to drop about the fourth day, and the spawn may be inserted as soon as it falls to 70° or 75° F. When a bed is seeded at a temperature above 80° F. the vitality is likely to be impaired.

**Cold Beds.** Not infrequently the temperature of the bed does not rise as here indicated. This is particularly true where a very small mass of compost has been prepared, and where the preliminary fermentation has been permitted to proceed farther than usual. Although annoying to the beginner, this condition does not worry the experienced grower, for he knows that with properly prepared compost his chances for success are not impaired, even though the temperature of the bed never rises above that of the room.

**Seeding The Bed.** When planting the spawn the bricks are broken into about a dozen pieces. These pieces are inserted to a depth of one or one-half inch, at intervals of ten inches, all over the bed. It is a mistake to plant spawn deeper than one inch. There is danger of the spawn "damping off" or "fogging off" should there be the slightest excess of moisture in the bed. At any rate, even though the bed is not too wet, the spawn will develop more rapidly when planted shallow than when planted deep.

A temperature about five degrees above the optimum (see page 10) during the first three or four weeks after planting will accelerate the development of the spawn and hasten the maturity of a bed.

**Never Dip Spawn.** Spawn, in the condition in which it must be handled in the market, is in a dormant stage. As soon as it is placed in a suitable temperature and moisture it again resumes active growth. In view

of these facts it will readily be understood how, by distributing the bricks over the newly made bed before it is ready for planting, the time between planting and fruiting may be reduced by several days. In no case however should spawn be dipped, or water applied direct to bricks.

## "Casing The Beds."

"Casing" consists in applying a layer of soil from one to one and a half inches deep to the surface of the mushroom bed. Any good garden soil is very satisfactory for this purpose. Sod, which has been piled up for several months, is excellent for casing purposes. Unless in fine condition, and free from clods and pebbles, the casing soil should be screened. The soil should be barely moist when applied. Smooth it down but do not pack it.

**Do Not Apply Casing Too Early.** A certain amount of æration of the mushroom bed is essential to a normal development of the spawn, therefore it is desirable to postpone "casing the beds" with loam until just before the first fruit begins to set. As a guide to the inexperienced grower it is recommended that he "case" the bed when the growing spawn begins to show in mould-like spots on the surface of the compost—usually 3 or 4 weeks after planting.

**Why Are Beds "Cased" With Soil?** Since the soil casing, if applied very soon after planting, may cause an insufficient æration of the beds, why not dispense with it altogether? It is essential to a maximum production of mushrooms. Some writers maintain that spawn will not fruit if beds are not "cased". This is a mistake. The casing forms a firmer stratum, a firmer support for the mushrooms, a cleaner picking surface, and affords a protection to the spawn. It is as a protection to the spawn that the casing becomes an essential factor in determining the yield of a bed. Without it it is almost impossible to pick a mushroom and not disturb the adjacent spawn. This disturbance results in injury which soon develops into a diseased condition affecting the entire spawn growth; hence such beds soon cease bearing. The casing also modifies evaporation and prevents sudden changes of temperature with-

in the bed, thereby making conditions which directly influence the quality of the product and the yield of a bed more favorable.

## Watering Mushroom Beds.

Water is the principal medium through which plant food passes from without into the plant. Food can enter the plant only in solution, therefore water is essential to plant growth. During the early stages of growth spawn is very sensitive and is easily injured by an excess of moisture. Under favorable conditions and with a proper degree of moisture present in the compost when beds are planted, very little water, if any, need be applied during the first three or four weeks. The average bed requires a light spraying once a week. One gallon for 100 sq. feet is usually sufficient at this time.

**Damping Off.** The condition referred to as "damping off" of spawn immediately after planting is a direct result of too much water. It is analagous to the rotting of seeds when planted in a very wet soil. The presence of much "free water" closes the pores in the soil or bed. This excludes the supply of oxygen essential to the growth of the plant and prevents the escape of carbon dioxide given off by the growing spawn, which, through its poisonous effect, inhibits further growth.

**Mulching In-Door Beds.** If the bed is exposed to a dry atmosphere, as in sheds, stalls, etc., it should be covered with a mulch of straw as soon as made up. This straw covering should be replaced after planting and should remain on the bed until the crop is gathered. (Damp sacking is sometimes used for covering the beds. This, however, is likely to prevent sufficient ventilation and may thus injure the spawn. Hay, also, is unsatisfactory for covering the bed). Examine the moisture condition of the bed just before planting. Sometimes the heat resulting from fermentation after the bed is made up dries out the interior of the bed. After planting it may be necessary to spray the bed lightly once a week (except in caves or where the beds are covered with straw) until the soil casing is applied, but do not water heavily.

**Fruiting Beds Require More Water.** When the bed has begun fruiting more water is required. The mushroom contains more than ninety per cent of water, hence with each picking nine-tenths of the weight removed is water. The experienced grower knows the effect of spraying on young mushrooms. Water applied direct to the young mushrooms—"pin-heads"—almost invariably causes a large number to die. While it is impossible to save all, and bring every young mushroom to maturity, much harm is done by careless watering. When watering beds it should be done after picking.

**Warm Water Injurious.** Numerous writers recommend spraying the beds with warm water—water about 80° or 90° F. The temperature of the bed is usually between 55° and 65° F. Is it surprising that the spawn and mushroom suffers injury under such treatment? A large per cent of the "pin-heads" and "buttons" die. Water at a temperature very near that of the bed is most satisfactory.

**Moisture In Interior Of Bed.** One good spraying every week or ten days, as conditions may demand, is preferable to just a light spraying daily or every two days. When spraying mushroom beds sufficient water should be applied to penetrate through the soil casing. Instances demanding a spraying sufficient to penetrate far into the compost beneath the casing are exceptional; still such extremes sometimes occur. In such cases however, where the interior of the bed has become very dry, it is more satisfactory to punch holes in the bed at intervals of about twenty inches and pour water into these holes, thereby getting it into the interior of the bed without saturating the casing.

**Sub-Watering.** It will be seen that this process is similar to sub-watering. It has been suggested that sub-watering may prove more satisfactory in mushroom culture than surface spraying, and experiments along this line are now under way. It is believed that much of the loss resulting from spraying (such as destruction of "pin-heads") may be averted by sub-watering. Under present methods of mushroom culture, sub-watering would of course be limited to floor beds only. "Sub-Watering In Greenhouses" in Farmers' Bulletin

No. 78, contains valuable suggestions on this topic.

## Picking The Crop.

**How To Pick The Mushroom.** After a bed has commenced bearing the mushrooms should be picked as soon as they have attained the stage desired. During cool weather it will be necessary to remove the mature plants at least every two days, while in a temperature above 60° F. they should be picked daily. To pick the mushroom, grasp it lightly between the thumb and fingers and, without lifting it the least bit give it a slight twist to separate it from the spawn. It can then be lifted up without destroying the spawn or adjacent mushrooms. The experienced grower realizes that great care is necessary in picking mushrooms and that the yield of a bed may be greatly reduced by careless gathering of the crop.

**The Most Profitable Stage.** For the general trade it is desirable to pick the mushroom just as the veil is ready to break, before the gills have lost their beautiful pink color. Taken at this stage the flavor will please the most exacting tastes. It is at this stage that the mushroom has attained its maximum weight and, therefore, viewed from the standpoint of the grower, it is the most profitable stage at which the plant can be picked. Since the mushroom does not gain in weight after the veil is broken, all nourishment taken from the spawn after this, enters into the process of spore formation. It is economy on the part of the grower here again to avoid an unnecessary tax on the food supply in the bed by preventing mushrooms from developing mature spores.

**When Cutting Is Essential.** If there is a large cluster of mushrooms, and they are grown together in such a manner as to make it impossible to pick out the mature plants without destroying the others, it is necessary to cut the stems of the mature plants. As soon as the entire cluster is removed the stubs must be taken out, otherwise decay will set in and injure the spawn. With this one exception, cutting is never as satisfactory as picking because there is always danger of stubs being left on the beds too long, thus inviting disease.

## Preparing The Mushroom For Market.

Mushrooms, when picked, should be carefully placed into large flat baskets to be taken to the sorting table where they are cleaned and sorted, or graded. Some growers cut off the base of the stem as soon as the mushroom is picked, while others leave this to be done in the sorting room. It is becoming more and more the custom with short stemmed varieties not to cut the stems. The soil and bits of spawn adhering to the base of the stem are brushed off and a small piece of oiled-tissue paper is placed as a cap over the end of the stem. This method has several advantages over that of cutting the stems: there is less waste and less shrinkage. Long stems make an unsightly package and do not take well on the market, hence a certain amount of trimming is necessary with long stemmed mushrooms.

A Camel's Hair Brush should be used for brushing any adhering loam off the cap. As the mushrooms are being sorted they are packed into baskets or boxes for the market. "Broilers" (mature mushrooms) and "buttons" (mushrooms picked before the veil begins to break) should be packed separately. Mushrooms of inferior grade should not be placed in the same package with others.

## Packing Mushrooms For Market.

Various forms of packages are used for marketing mushrooms. Baskets are frequently used where the product is taken by hotels in lots of 4 to 12 pounds or more. Sometimes the product sold through the commission merchant is handled in baskets, but one-pound boxes are preferable. The mushroom is a plant which quickly shows handling and bruises. By packing mushrooms in one-pound boxes at the sorting table no further handling is necessary. They are distributed in the original package direct to the consumer. The ordinary lunch box* (a folding box) makes a very satisfactory one-pound mushroom box. For shipping to distant markets the boxes may be packed into baskets or crates. By lining the box with a blue oiled-tissue paper a very attractive package is obtained.

## Period Of Production.

Mushroom beds usually begin bearing between the

* These boxes usually cost $6 to $7 per one thousand.

fifth and eighth weeks after planting. Earliness of maturity depends on the variety of spawn used, on the temperature and moisture condition, and upon the material and the extent of decomposition. The Eureka variety matures earlier than varieties of the *campestris* species. Almond, on the other hand, matures later than the other varieties. Beds for which the manure has not been fermented sufficiently will not fruit as early as beds made up of well fermented compost. A temperature below the optimum retards growth and fruiting, whereas a temperature above the optimum hastens fruiting. Forcing the crop at a high temperature, however, is at the expense of quality and the product is of an inferior grade. Fertilization hastens maturity by about ten days.

The Average Life of a mushroom bed is about 2 1-2 months. Not infrequently, however, the bed continues to yield profitable returns for three or four months. Some writers, particularly unscrupulous spawn growers exploiting the extraordinary merits of their spawn, claim that a mushroom bed bears continually for eight or nine months. If such cases are on record they are rare exceptions. There is no question but what a mushroom bed will continue to produce a few mushrooms throughout a period of nine to twelve months, or even longer, but the yield is so small and the quality of such an inferior grade that, after three or four months, under the present culture methods, the bed is no longer profitable.

Early Fruiting. The most profitable beds are those which begin bearing early. This alone is an indication of a vigorous spawn growth and favorable conditions generally. The fruit invariably is larger and of better quality than that from late beds where the crop extends over a much longer period. The yield from early beds is always greater than from beds slow in maturing.

After a bed has been fruiting a week or ten days it enters the first "resting period," and for almost a week it may produce very few mushrooms. It then produces another crop of mushrooms, lasting about ten days, when it again enters a "resting period." This may be repeated a half dozen times.

To Increase The Life Of A Bed. With a better

understanding of the problem of fertilization it is probable that in the near future the grower, by the addition of a properly balanced commercial fertilizer, will not only further increase the yield but will also lengthen the bearing period of the mushroom bed.

## Old Beds.

When a bed has ceased to bear or is no longer profitable commercially, examine the spawn to see whether it is exhausted or not. If the spawn is of a yellowish-brown appearance it is dead and the bed should be taken up and removed from the cave, cellar or house. If, however, the spawn is white and fresh, and has the odor of mushrooms, the bed may be reinvigorated by applying a solution of dibasic potasium phosphate. Dissolve one ounce of the salt in each gallon of water used for watering the bed.

Some growers use liquid manure as a stimulant to prolong the life of a bed. While this may prove effective to a limited extent in some cases, it is a very wasteful and inconvenient method, and is impracticable in many instances.

The manure in old beds is a very valuable fertilizer for garden or lawn but is wholly useless for further mushroom growing. When the bed is removed the house, cellar, or cave, should be thoroughly cleaned, and, if possible, sprayed with a solution of hot lime, or fumigated with bi-sulphide of carbon (1 pound per 1000 cu. ft.) for 24 hours. Brimstone is used as a fumigant in some of the mushroom plants of this country, but it is not as effective as bi-sulphide of carbon.

If conditions are favorable new beds may be installed immediately after the old beds have been removed.

## Shelf Beds.

Shelves in the mushroom house are a means by which the area of beds for a given floor space may be doubled, trebled, or quadrupled (see Fig. 2). From this it may readily be inferred that shelf beds are most commonly employed where floor space is limited. It is indeed recommended that their use be restricted to plants of limited floor space, for it is here alone that shelf beds prove advantageous.

More labor is required in making up shelf beds and the yield is never quite as heavy as that from floor beds, hence the addition of one shelf in your mushroom cellar, although it may double your area of beds, will not necessarily double the yield of mushrooms. The fruiting period is usually shorter than that of floor beds. Variable conditions of moisture and temperature more quickly effect shelf beds than floor beds.

The condensation of moisture on the ceiling of the mushroom house is likely to cause the top bed to become very wet, while the beds below this (particularly the middle bed, if more than one shelf is used) become dry. These conditions must be carefully looked after. It may be advisable to stretch a canvas, slanting like a roof, over the top bed to prevent it from getting too wet.

In erecting shelves in the mushroom house they should be constructed in such a manner that every part except the post supporting same may be removed and whitewashed after each crop. Cleats, supporting the sills or joists, should be nailed on the upright posts. The floor and side boards are held in position by the bed, hence no nailing is required. Boards 1x8 inches are suitable for shelving. Shelf beds should be 8 to 10 inches deep.

## Mushroom Troubles.

If your mushroom cellar, house or cave, is thoroughly cleaned when beds are removed there is little danger from insect depredations. There are a few common pests, however, which sometimes become injurious. Not infrequently, when conditions are unfavorable, other fungi attack the spawn and mushrooms and thus cause disease which results in a loss to the grower. These several enemies, particularly simple remedies for overcoming their harmful effects, are here briefly discussed.

Fogging Off. One of the most common troubles, particularly of the beginner, in mushroom growing is the loss of a large per cent of the crop after the fruit has already set. The mushrooms—from the "pin head" stage until maturity—turn brown and wither. This condition is called "fogging off." The principle cause of this trouble is a disturbance or injury of the spawn,

usually by careless picking. "Fogging off" is therefore rarely noticable until about two weeks after picking began.

Black Spot, as the name indicates, is a disease which manifests itself by the appearance of numerous black spots on the surface of the cap. It is generally due to insufficient ventilation and to the use of warm water in spraying the beds.

Flies. Small manure flies sometimes appear in such numbers as to become a nuisance in the mushroom house, particularly during the later stages of the life of a bed. These flies are not the result of unfavorable conditions or carelessness about the mushroom house for they inhabit manure wherever it may be. They are harmless and become a nuisance only in so far as they crawl about over the mushrooms and, unless carefully brushed off, may remain in hiding between the gills as the mushroom is packed for the market. Burning tobacco stems, thus producing a dense smudge in the mushroom house, will destroy these flies. The larvæ of this fly (a small white worm) appearing in the manure, may be destroyed by sprinkling the bed with a very dilute solution of ammonia.

Maggots. During warm weather, as soon as the temperature exceeds 65° F., it is almost impossible to prevent flies from entering the mushroom house (any structure above ground). In underground structures—caves, deep cellars, tunnels and mines,—which are constantly in absolute darkness, this trouble is eliminated. Wherever these flies occur they deposit their eggs in the compost of the bed and in the young mushrooms. These eggs develop into larvæ which infest the mushroom, and usually by the time it is ready to pick the whole interior is completely destroyed. The only remedy against larvæ is to exclude or destroy the fly. After the egg has once been deposited in the mushroom there is no preventive. Fumigation (1-2 pound carbon bisulphid for 1000 cu. ft.) for 24 hours will destroy the flies and not injure the mushrooms.

Sow Bugs Or Wood Lice. These 14-legged crustaceans make their habitat under boards and often frequent the crevices around the mushroom bed. Since they feed on spawn and mushrooms they are injurious

to the crop. Remedy: Common insect powder purchased at any drug store and scattered over the bed. Another remedy is to sprinkle sliced potatoes with arsenic and paris green and place these where the bugs will feed on them. This latter remedy is poisonous and must be handled carefully. Insect powder is harmless.

Mites. When the temperature of the mushroom house is above 60° F. one or two species of mites frequently infest the beds. When very abundant their injury to the spawn and mushrooms becomes readily perceptible. Remedy: Spread tobacco stems all over the bed. Remove the stems when they begin to decay.

It should be remembered that the use of commercial fertilizers in mushroom culture will greatly reduce the danger from such insects that breed in the compact—e. g. flies, larvæ, etc.

## How To Serve Mushrooms.

Button mushrooms should never be peeled nor sliced. Wash and wipe them clean with a wet cloth. The stems of button mushrooms are very tender and should not be removed. Mature mushrooms, however, should be peeled. To peel them, begin at edge drawing the peeling towards center of cap. The stems of mature mushrooms are usually removed and used in meat stews, soups or gravies. Never soak mushrooms in salt water. A thorough rinsing will remove all insects that may adhere to the gills. Soaking them destroys the delicate flavor.

Mushrooms can be cooked in the same manner as oysters; either stewed, fried, broiled or as a soup. They are used extensively as a condiment to flavor sauces, catsups, meat gravies, game and soups.

Baked Mushrooms. Wash and peel a pound of mushrooms. Put in a baking pan and season with salt, pepper, chopped parseley and lemon juice. Cook in moderate oven about 15 minutes. Arrange in a dish and pour over gravy which has been prepared as follows: one cup cream, one tablespoonful butter, a little pepper and salt, two tablespoons full lemon juice, thickened with corn starch.

Another way is to place the peeled and sliced mushrooms into a pan, add a cup of cold water into which a teaspoonful of flour has been stirred, salt

pepper, a little chopped onion and a teaspoonful of butter. Put in oven 15 or 20 minutes. Serve while hot.

Mushrooms And Tomatoes On Toast. Use large ripe tomatoes and the caps of mature mushrooms. Slice the tomatoes and spread on slices of bread, then place the mushroom caps, gills up, on the tomatoes. Place a small piece of butter in center of each cap and add a little salt and pepper. Put in moderate oven until bread is toasted. Serve immediately. This makes a fine breakfast dish.

Mushrooms On Toast. A variation of the above formula is to lay the slices of bread into a baking pan, covering them with the mushrooms, gills up. Sprinkle with salt and pepper and place a piece of butter the size of a hazelnut in each cap. Put into moderate oven until bread is toasted. Serve at once.

Stewed Mushrooms. Prepare, as for baking, one quart of mushrooms. Have ready in a stew pan: one tablespoonful melted butter and half an ounce of chopped onion. Add the mushrooms and sprinkle with a little salt and pepper. Stew gently for about 20 minutes. Then add a cup of cream and stew about 10 minutes longer. Thicken with corn starch or cracker crumbs and serve while hot. This goes fine on toast.

Fried Mushrooms. Cut the mushroom into nice round slices; have ready a batter prepared with eggs and milk, as for batter cakes. Dip slices in this and fry a nice brown in hot lard.

Another good way is to dip them in egg alone; roll in cracker crumbs or flour; dip in beaten egg again and fry as above.

As in cooking vegetables, there is a great variety of ways in which the mushroom may be prepared for the table. There are numerous variations of the methods given above. The purpose in giving these formulæ is to suggest to the reader how readily the method might be changed just a little and yet the resulting dish will be quite different. For additional receipts the reader should consult any of the standard cook books.

## Preserving Mushrooms.

Canning Mushrooms. Peel the mushrooms and

bleach them by dipping into boiling water, containing for each gallon three ounces of salt and the juice of two lemons. After five minutes remove the mushrooms to clean pint jars and cover with a brine prepared by adding two ounces of salt and a little lemon juice to each gallon of water. Then bring gradually to boiling point and boil for 15 minutes.

Preserving In Butter. Wash and peel the mushrooms and immerse for a few minutes in cold water to which a little lemon juice has been added. Wipe them dry and use for every pound of mushrooms 1-4 pound of butter, a teaspoonful of salt, a little pepper and the juice of one lemon. Melt the butter in a stew pan, add the mushrooms and seasonings, and cook slowly until nearly dry, shaking to prevent sticking. Then put into jars and fill with butter. Heat in boiling water for ten minutes, close the top, cool gradually and seal.

Drying Mushrooms. The process of drying mushrooms is simpler than that of canning. To obtain best results, thoroughly clean the mushrooms and then immerse them for a moment in boiling water to which has been added a little lemon juice or some vinegar. After removing the mushrooms from the water they are dried, either by stringing them on threads to be hung over the stove or in a sunny place, or by distributing them over a wire netting suspended over the stove. In drying large quantities it is desirable to dessicate them in a drying oven at a temperature near that of boiling water. The dried product should be stored in air tight boxes or tins.

Mushroom growers will find the drying process of value as a means of utilizing portions of stems and mushrooms too far advanced for the demands of the best markets. Dried mushrooms may be reduced to a powder by passing through an ordinary grinder. This powder is in considerable demand for sauces and seasoning.

## Mushroom Spawn.

The completement to this volume ("Pure Culture Spawn," Fifth Edition) is devoted largely to a discussion of mushroom spawn, hence this subject need not be entered into here. The era has come in mushroom

culture when the superiority of Pure Culture Spawn has been fully established and no progressive grower of today would consider the use of spawn produced by the old "chance method." The following table taken from

TABLE SHOWING YIELD OF DIFFERENT KINDS OF SPAWN.

| No. of the bed | Kind and Source of Spawn Used | No. of days to produce mushrooms | Yield in ounces first 30 days | Yield in ounces second 30 days | Yield in ounces per square foot of bed |
|---|---|---|---|---|---|
| 2 | Old American made | 104 | 20 | . . . | 3.6 |
| 3 | English, current year market product | 51 | 7 | . . . | 1.0 |
| 31 | English commercial, St. Louis | . | . | . | 0.0 |
| 32 | English commercial, New York | . | . | . | 0.0 |
| 33 | Bohemia variety, American commercial | 42 | 70 | 32 | 17.0 |
| 34 | Alaska variety, American commercial | 46 | 70 | 31 | 16.7 |
| 35 | French, commercial flake | . | . | . | 0.0 |
| 20 | Bohemia variety, Pure Culture | 48 | 101 | 39 | 23.3 |
| 22 | American commercial, more than one year old | . | . | . | 0.0 |
| 23 | American commercial, Bohemia variety | 53 | 111 | 53 | 20.5 |

Above figures are taken from Table VIII, B. P. I. Bulletin No. 85, U. S. Dept. of Agriculture.

"Pure Culture Spawn is such a gem that it merits reproduction here. Use only the best varieties of Pure Culture Spawn. Spawn must be used while fresh to obtain maximum results.

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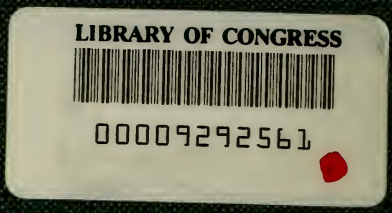
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